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Effect of Surface Conditions on PM_{10} Dust Emissions, Owens Lake, CA

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The diversion of water from the Owens River by the City of Los Angeles resulted in the drying up of Owens Lake by 1926. The present dry lakebed is subject to frequent dust storms from October to May and represents one of the largest single sources of airborne particulate matter in the Western hemisphere (Gill, 1996).

To evaluate the temporal and spatial variability of PM_{10} dust emission wind tunnel tests were undertaken at 30 sites, primarily located in the Central Area of the lakebed with a few sites in the Southern portion. Tests at each site consisted of 4 components: a) soil sample collection, b) determination of threshold shear velocity, c) measurement of PM_{10} dust emissions without sand feed, followed by d) measurement of PM_{10} dust emissions with sand feed.

Vertical dust emissions (F) for the lake sites without-feed ranged from approximately 3.29×10^{-1} to 5.12×10^{4} $\mu g/m^2s$ and from 7.79 to 5.46×10^{4} $\mu g/m^2s$ for the with-feed runs. In general, there were somewhat higher F values for the with-feed runs reflecting the importance of sand bombardment as a principal mechanism for dust entrainment. Although much higher F values were expected for the with-feed runs the less than expected increase is likely attributable to the very hard surface crusts and lack of particulates available for entrainment at the surface for many of the sites examined during the wind tunnel tests.

Recent research indicates that the ratio F/q for a given surface is a direct function of the binding energies that hold particles at the surface and of the kinetic energy of impacting saltation particles as determined by particle mass. The F/q ratio ranged from 6.33×10^{-8} m^{-1} to 7.88×10^{-4} m^{-1} with a median value of 1.21×10^{-5} m^{-1} for the without-feed lake site tests. A very similar range was found for the with-feed cases (6.61×10^{-8} m^{-1} to 2.18 10^{-4} m^{-1}), although the median value was somewhat lower (5.52×10^{-6} m^{-1}). In general the F/q ratios determined from the wind tunnel testing are smaller for similar u_* values than the single ratio derived by Gillette *et al.* (1997) from tower and sand trap measurements but are similar to those found during the 2000 wind tunnel tests and are also consistent with recent work by Alfaro et al. (1997, 1998).

The wind tunnel test results indicate the importance of changing surface conditions on dust emissions as a result of precipitation events and high evaporation rates associated with rapid drying of the surface and the formation of very hard-cemented crusts. This dramatic change in surface conditions as the season progressed resulted in a noticeable decrease in the quantity of entrainable sediment and significantly lower and somewhat irregular emissions and associated dust concentrations during the wind tunnel tests irrespective of soil type.